Fig. 1

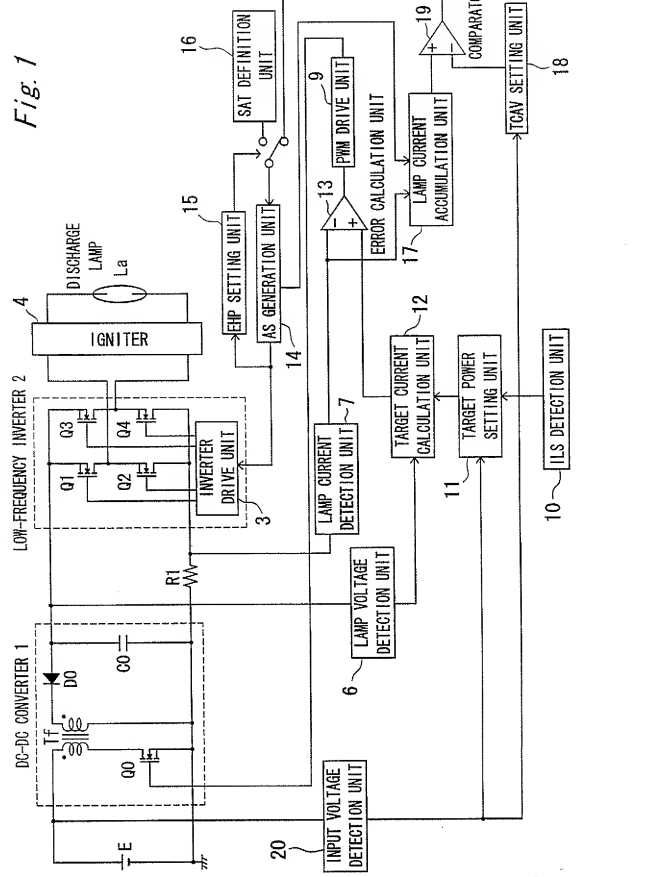

DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
DISCHARGE LAMP La
IGNITER
INVERTER DRIVE UNIT
LAMP CURRENT DETECTION UNIT
LAMP VOLTAGE DETECTION UNIT
INPUT VOLTAGE DETECTION UNIT
ILS DETECTION UNIT
TARGET POWER SETTING UNIT
TARGET CURRENT CALCULATION UNIT
EHP SETTING UNIT
AS GENERATION UNIT
SAT DEFINITION UNIT
PWM DRIVE UNIT
ERROR CALCULATION UNIT
LAMP CURRENT ACCUMULATION UNIT
COMPARATOR
TCAV SETTING UNIT
Q0
Q1
Q2
Q3
Q4
D0
C0
Tf
R1
E
3
4
6
7
9
10
11
12
13
14
15
16
17
18
19
20

Fig. 2

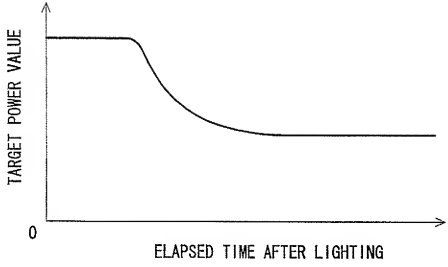

TARGET POWER VALUE
0
ELAPSED TIME AFTER LIGHTING

Fig. 3

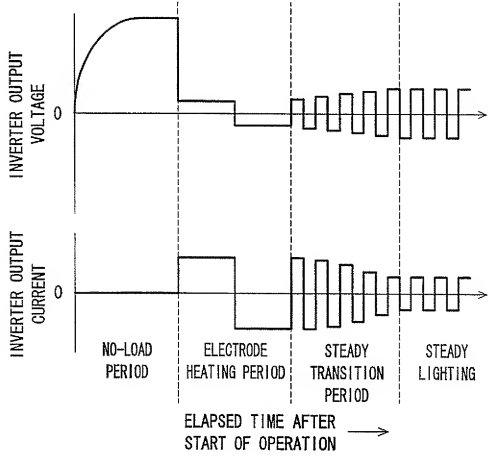

INVERTER OUTPUT VOLTAGE
0
INVERTER OUTPUT CURRENT
0
NO-LOAD PERIOD
ELECTRODE HEATING PERIOD
STEADY TRANSITION PERIOD
STEADY LIGHTING
ELAPSED TIME AFTER START OF OPERATION

Fig. 4A

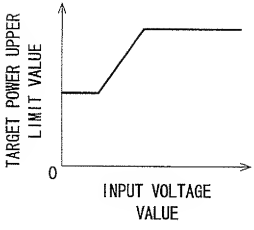


Fig. 4B

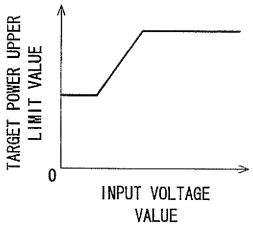


Fig. 4C

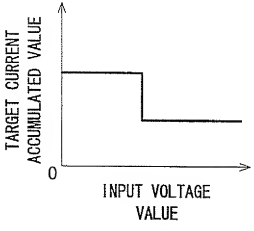


Fig. 4D

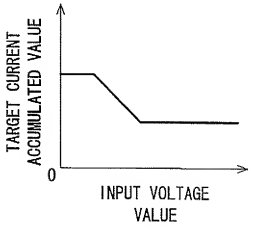


Fig. 5

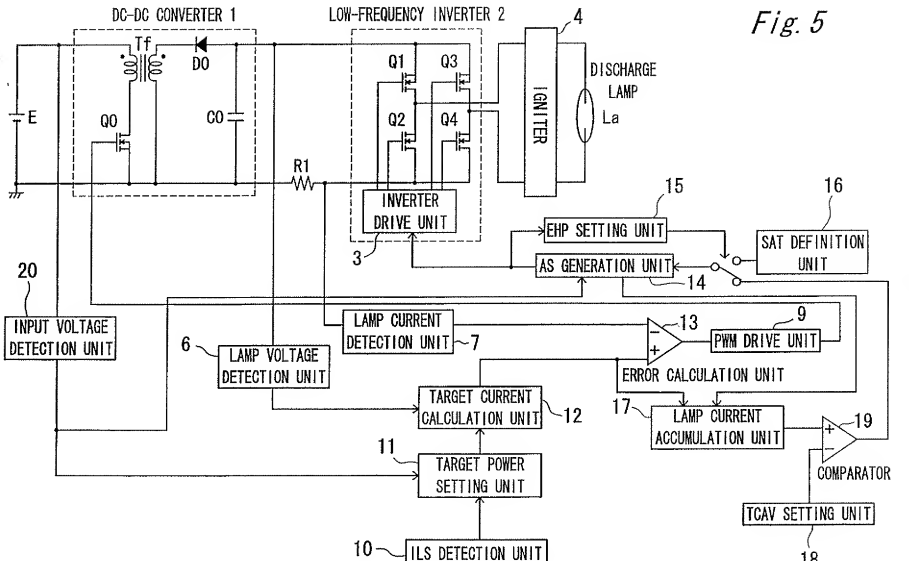

DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
4
Tf
D0
Q1
Q3
DISCHARGE LAMP La
IGNITER
E
Q0
C0
Q2
Q4
R1
15
16
INVERTER DRIVE UNIT
EHP SETTING UNIT
SAT DEFINITION UNIT
3
AS GENERATION UNIT
14
20
INPUT VOLTAGE DETECTION UNIT
LAMP CURRENT DETECTION UNIT
7
13
9
PWM DRIVE UNIT
6
LAMP VOLTAGE DETECTION UNIT
ERROR CALCULATION UNIT
TARGET CURRENT CALCULATION UNIT
12
17
LAMP CURRENT ACCUMULATION UNIT
19
11
TARGET POWER SETTING UNIT
COMPARATOR
TCAV SETTING UNIT
10
ILS DETECTION UNIT
18

Fig. 6

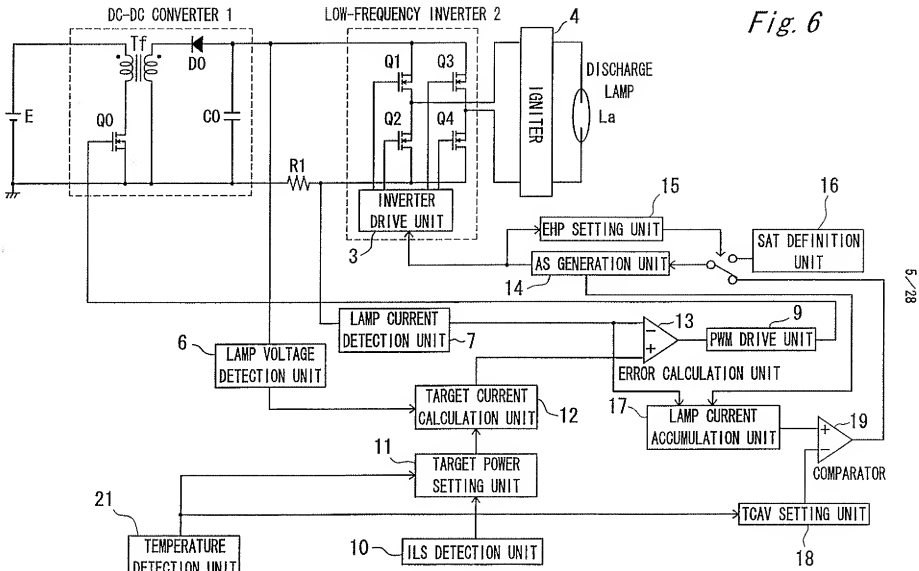

DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
Tf
D0
Q0
C0
E
R1
Q1
Q3
Q2
Q4
IGNITER
4
DISCHARGE LAMP La
INVERTER DRIVE UNIT
3
15
EHP SETTING UNIT
16
SAT DEFINITION UNIT
AS GENERATION UNIT
14
LAMP CURRENT DETECTION UNIT
7
6
LAMP VOLTAGE DETECTION UNIT
13
9
PWM DRIVE UNIT
ERROR CALCULATION UNIT
TARGET CURRENT CALCULATION UNIT
12
17
LAMP CURRENT ACCUMULATION UNIT
19
COMPARATOR
11
TARGET POWER SETTING UNIT
21
TCAV SETTING UNIT
18
TEMPERATURE DETECTION UNIT
10
ILS DETECTION UNIT

Fig. 7

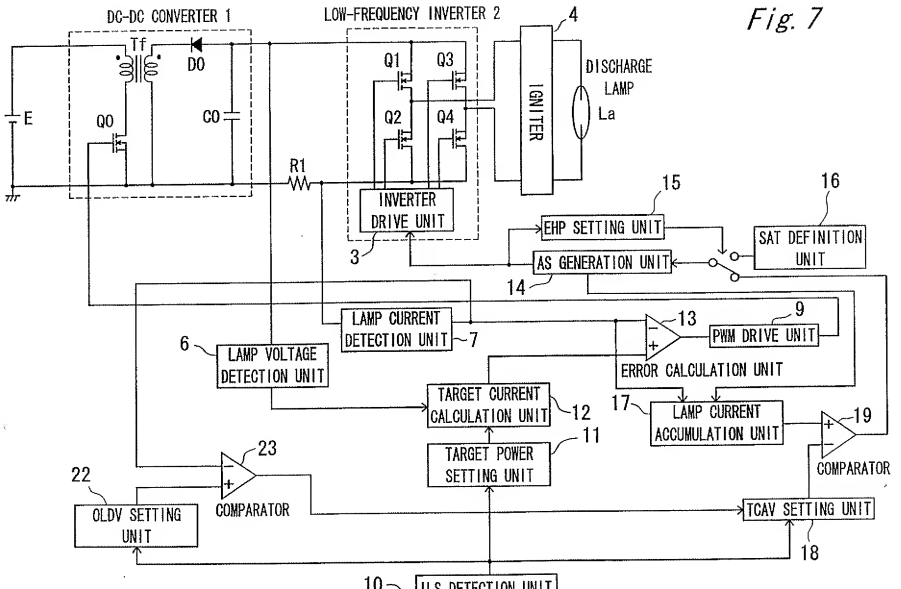

DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
4
Tf
DO
Q1
Q3
DISCHARGE LAMP
E
Q0
C0
Q2
Q4
IGNITER
La
R1
INVERTER DRIVE UNIT
3
15
16
EHP SETTING UNIT
SAT DEFINITION UNIT
AS GENERATION UNIT
14
LAMP CURRENT DETECTION UNIT
7
13
9
PWM DRIVE UNIT
6
LAMP VOLTAGE DETECTION UNIT
ERROR CALCULATION UNIT
TARGET CURRENT CALCULATION UNIT
12
17
LAMP CURRENT ACCUMULATION UNIT
19
TARGET POWER SETTING UNIT
11
COMPARATOR
23
22
OLDV SETTING UNIT
COMPARATOR
TCAV SETTING UNIT
18
10
ILS DETECTION UNIT

Fig. 8

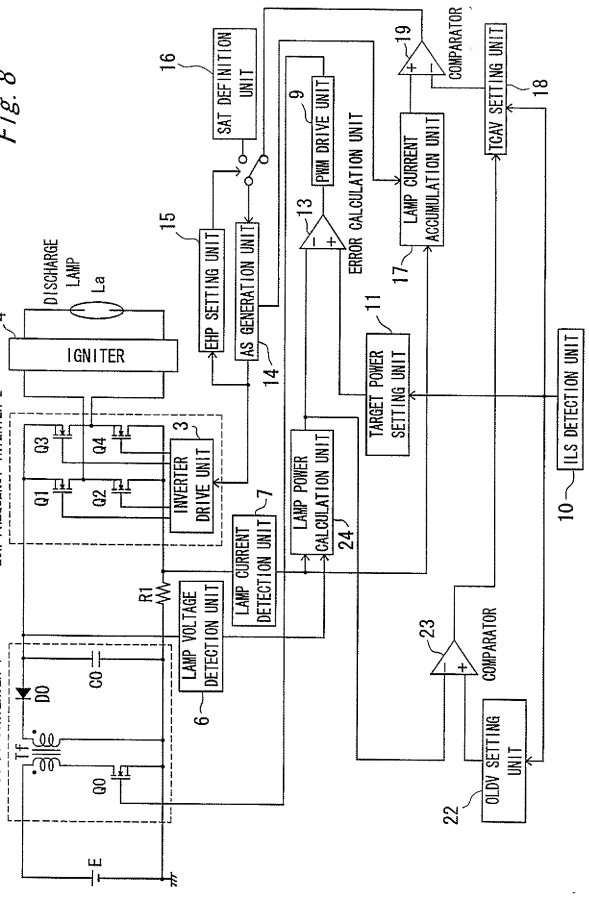

DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
DISCHARGE LAMP La
IGNITER
4
INVERTER DRIVE UNIT
3
Q1
Q2
Q3
Q4
Q0
Tf
D0
C0
R1
E
LAMP VOLTAGE DETECTION UNIT
6
LAMP CURRENT DETECTION UNIT
7
LAMP POWER CALCULATION UNIT
24
EHP SETTING UNIT
15
AS GENERATION UNIT
14
SAT DEFINITION UNIT
16
PHM DRIVE UNIT
9
13
ERROR CALCULATION UNIT
TARGET POWER SETTING UNIT
11
LAMP CURRENT ACCUMULATION UNIT
17
19
COMPARATOR
TCAV SETTING UNIT
18
ILS DETECTION UNIT
10
23
COMPARATOR
OLDV SETTING UNIT
22

Fig. 9

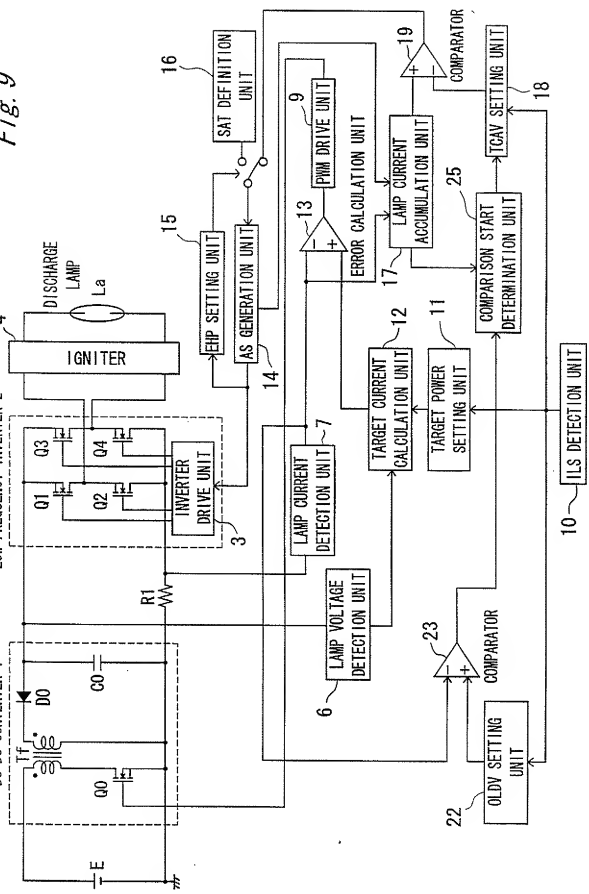

DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
DISCHARGE LAMP La
IGNITER
INVERTER DRIVE UNIT
LAMP CURRENT DETECTION UNIT
LAMP VOLTAGE DETECTION UNIT
TARGET CURRENT CALCULATION UNIT
TARGET POWER SETTING UNIT
ILS DETECTION UNIT
COMPARISON START DETERMINATION UNIT
LAMP CURRENT ACCUMULATION UNIT
TCAV SETTING UNIT
COMPARATOR
PWM DRIVE UNIT
ERROR CALCULATION UNIT
EHP SETTING UNIT
AS GENERATION UNIT
SAT DEFINITION UNIT
OLDV SETTING UNIT
COMPARATOR
E
TF
D0
C0
Q0
Q1
Q2
Q3
Q4
R1
3
4
6
7
9
10
11
12
13
14
15
16
17
18
19
22
23
25

Fig. 10

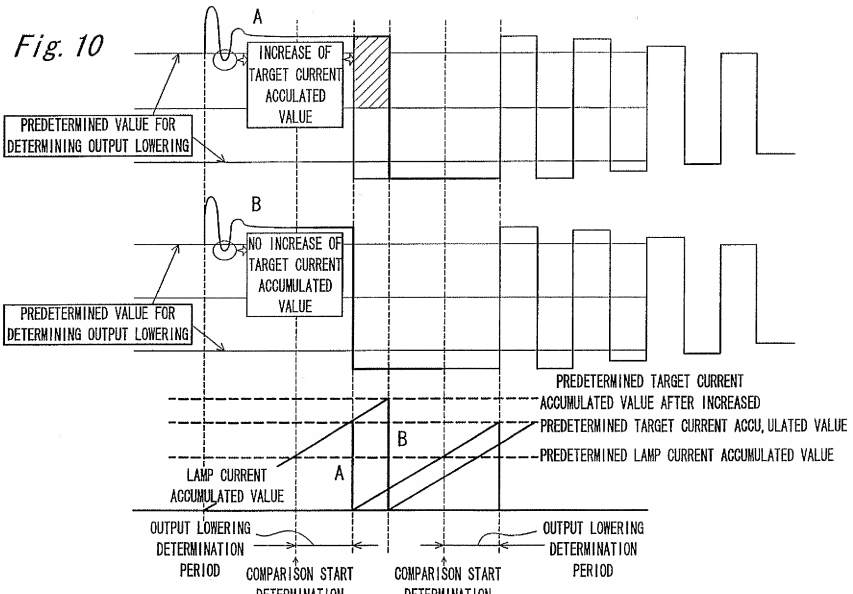

A
INCREASE OF TARGET CURRENT ACCULATED VALUE
PREDETERMINED VALUE FOR DETERMINING OUTPUT LOWERING
B
NO INCREASE OF TARGET CURRENT ACCUMULATED VALUE
PREDETERMINED VALUE FOR DETERMINING OUTPUT LOWERING
PREDETERMINED TARGET CURRENT ACCUMULATED VALUE AFTER INCREASED
PREDETERMINED TARGET CURRENT ACCU, ULATED VALUE
PREDETERMINED LAMP CURRENT ACCUMULATED VALUE
B
A
LAMP CURRENT ACCUMULATED VALUE
OUTPUT LOWERING DETERMINATION PERIOD
COMPARISON START DETERMINATION
COMPARISON START DETERMINATION
OUTPUT LOWERING DETERMINATION PERIOD

Fig. 11

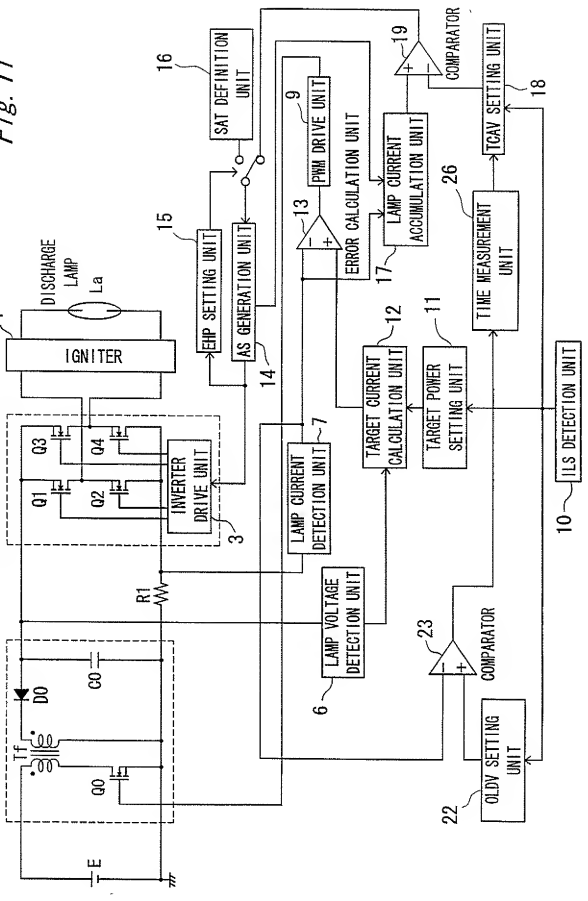

DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
DISCHARGE LAMP La
IGNITER
INVERTER DRIVE UNIT
LAMP CURRENT DETECTION UNIT
LAMP VOLTAGE DETECTION UNIT
TARGET CURRENT CALCULATION UNIT
TARGET POWER SETTING UNIT
TIME MEASUREMENT UNIT
ILS DETECTION UNIT
OLDV SETTING UNIT
COMPARATOR
ERROR CALCULATION UNIT
PWM DRIVE UNIT
LAMP CURRENT ACCUMULATION UNIT
TCAV SETTING UNIT
EHP SETTING UNIT
AS GENERATION UNIT
SAT DEFINITION UNIT
E
Tf
D0
C0
Q0
Q1
Q2
Q3
Q4
R1
3
4
6
7
9
10
11
12
13
14
15
16
17
18
19
22
23
26

Fig. 12A

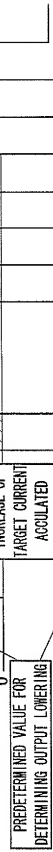


Fig. 12B

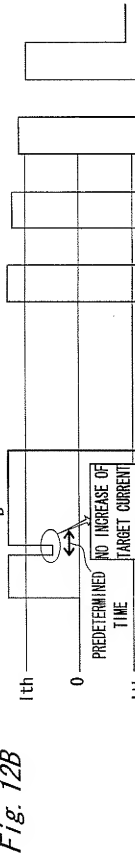


Fig. 12C

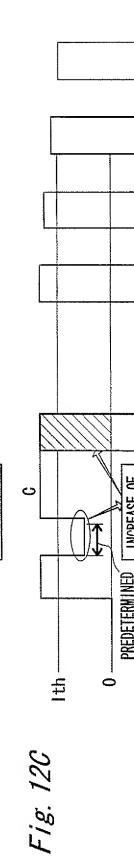
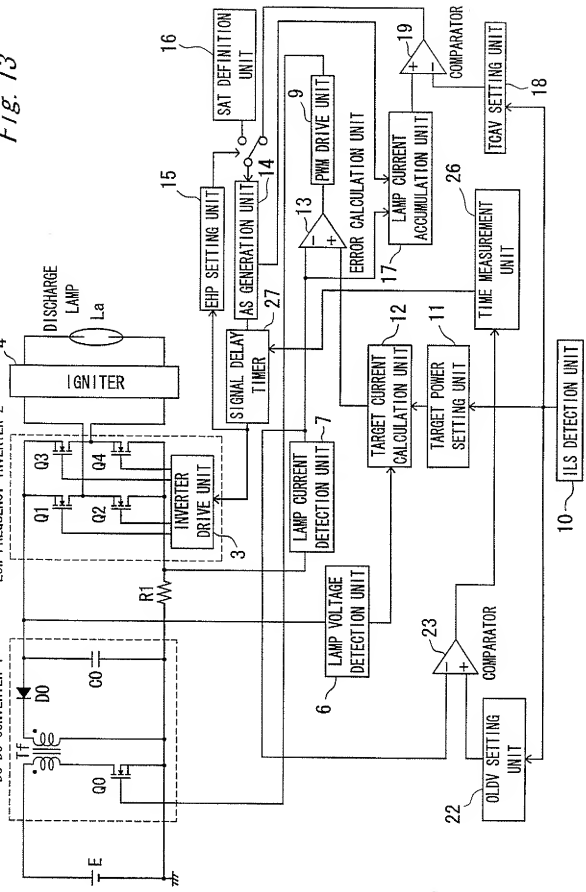


Fig. 13


DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
IGNITER
DISCHARGE LAMP La
INVERTER DRIVE UNIT
LAMP CURRENT DETECTION UNIT
LAMP VOLTAGE DETECTION UNIT
SIGNAL DELAY TIMER
EHP SETTING UNIT
AS GENERATION UNIT
SAT DEFINITION UNIT
PWM DRIVE UNIT
ERROR CALCULATION UNIT
LAMP CURRENT ACCUMULATION UNIT
COMPARATOR
TGAV SETTING UNIT
TIME MEASUREMENT UNIT
TARGET CURRENT CALCULATION UNIT
TARGET POWER SETTING UNIT
ILS DETECTION UNIT
OLDV SETTING UNIT
COMPARATOR
E
Tf
D0
C0
Q0
Q1
Q2
Q3
Q4
R1
3
4
6
7
9
10
11
12
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23
26
27

Fig. 14A

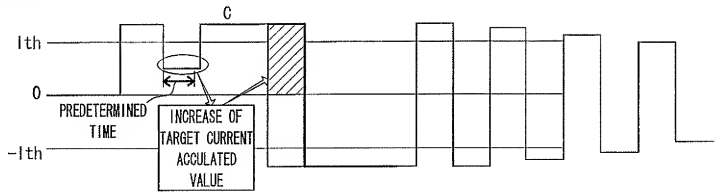

Fig. 14B

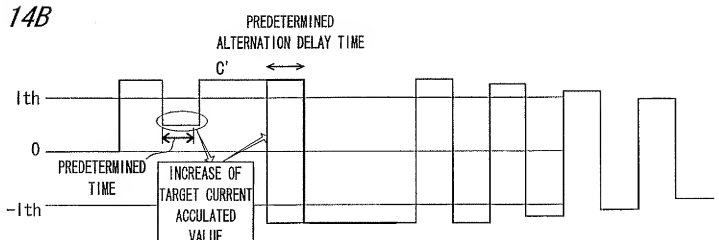

Fig. 15

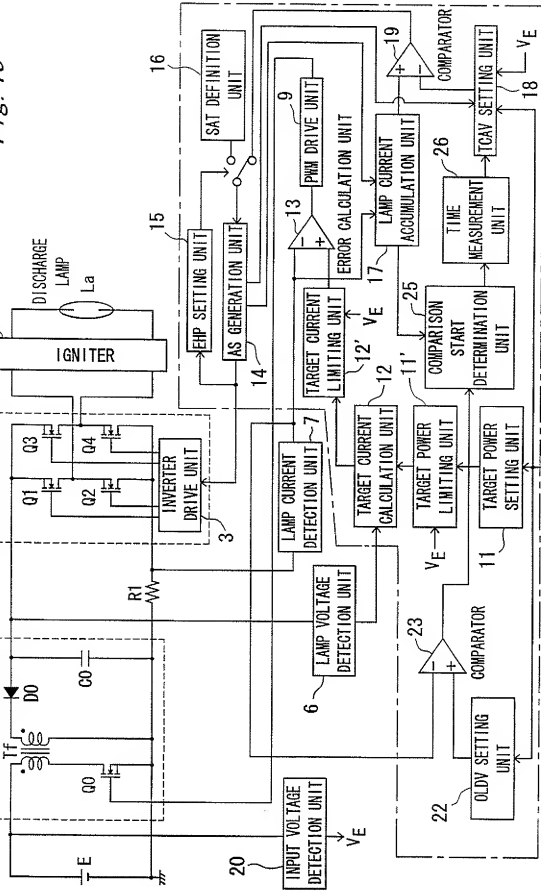
DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
DISCHARGE LAMP La
IGNITER
INVERTER DRIVE UNIT
LAMP CURRENT DETECTION UNIT
LAMP VOLTAGE DETECTION UNIT
INPUT VOLTAGE DETECTION UNIT
TARGET CURRENT CALCULATION UNIT
TARGET POWER LIMITING UNIT
TARGET POWER SETTING UNIT
ILS DETECTION UNIT
OLDV SETTING UNIT
COMPARATOR
TARGET CURRENT LIMITING UNIT
ERROR CALCULATION UNIT
LAMP CURRENT ACCUMULATION UNIT
COMPARISON START DETERMINATION UNIT
TIME MEASUREMENT UNIT
ITCAV SETTING UNIT
COMPARATOR
PWM DRIVE UNIT
SAT DEFINITION UNIT
EHP SETTING UNIT
AS GENERATION UNIT
Tf
D0
C0
Q0
R1
Q1
Q2
Q3
Q4
E
V_E
3
4
6
7
9
10
11
12
12'
11'
13
14
15
16
17
18
19
20
22
23
25
26

Fig. 16

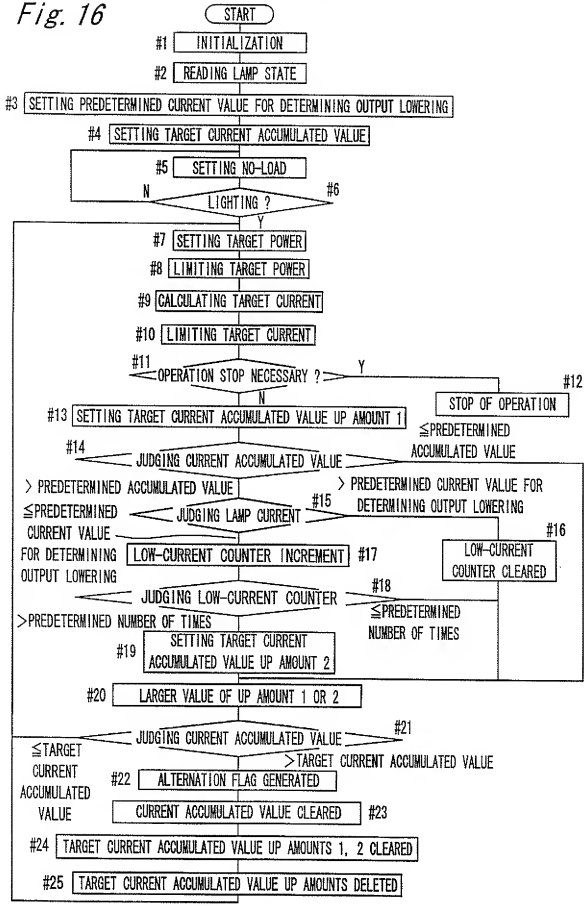
START
#1 INITIALIZATION
#2 READING LAMP STATE
#3 SETTING PREDETERMINED CURRENT VALUE FOR DETERMINING OUTPUT LOWERING
#4 SETTING TARGET CURRENT ACCUMULATED VALUE
#5 SETTING NO-LOAD
#6 LIGHTING ?
N
Y
#7 SETTING TARGET POWER
#8 LIMITING TARGET POWER
#9 CALCULATING TARGET CURRENT
#10 LIMITING TARGET CURRENT
#11 OPERATION STOP NECESSARY ?
Y
N
#12 STOP OF OPERATION
#13 SETTING TARGET CURRENT ACCUMULATED VALUE UP AMOUNT 1
#14 JUDGING CURRENT ACCUMULATED VALUE
≦PREDETERMINED ACCUMULATED VALUE
> PREDETERMINED ACCUMULATED VALUE
#15 JUDGING LAMP CURRENT
> PREDETERMINED CURRENT VALUE FOR DETERMINING OUTPUT LOWERING
≦PREDETERMINED CURRENT VALUE FOR DETERMINING OUTPUT LOWERING
#16 LOW-CURRENT COUNTER CLEARED
#17 LOW-CURRENT COUNTER INCREMENT
#18 JUDGING LOW-CURRENT COUNTER
≦PREDETERMINED NUMBER OF TIMES
>PREDETERMINED NUMBER OF TIMES
#19 SETTING TARGET CURRENT ACCUMULATED VALUE UP AMOUNT 2
#20 LARGER VALUE OF UP AMOUNT 1 OR 2
#21 JUDGING CURRENT ACCUMULATED VALUE
≦TARGET CURRENT ACCUMULATED VALUE
>TARGET CURRENT ACCUMULATED VALUE
#22 ALTERNATION FLAG GENERATED
#23 CURRENT ACCUMULATED VALUE CLEARED
#24 TARGET CURRENT ACCUMULATED VALUE UP AMOUNTS 1, 2 CLEARED
#25 TARGET CURRENT ACCUMULATED VALUE UP AMOUNTS DELETED

Fig. 17

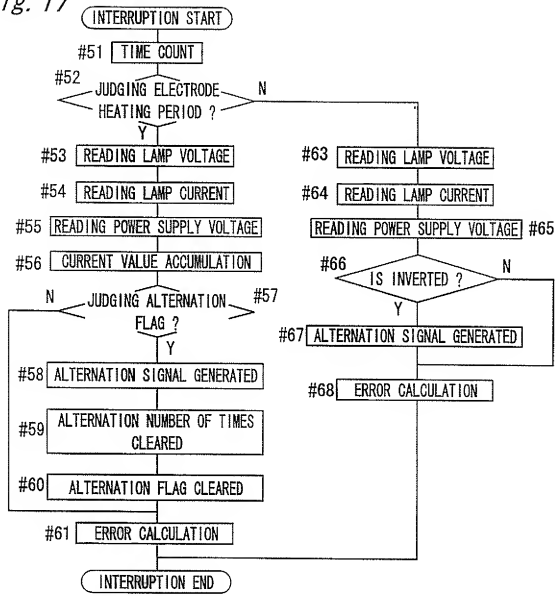
INTERRUPTION START
#51 TIME COUNT
#52 JUDGING ELECTRODE HEATING PERIOD ?
N
Y
#53 READING LAMP VOLTAGE
#54 READING LAMP CURRENT
#55 READING POWER SUPPLY VOLTAGE
#56 CURRENT VALUE ACCUMULATION
N
JUDGING ALTERNATION FLAG ?
#57
Y
#58 ALTERNATION SIGNAL GENERATED
#59 ALTERNATION NUMBER OF TIMES CLEARED
#60 ALTERNATION FLAG CLEARED
#61 ERROR CALCULATION
#63 READING LAMP VOLTAGE
#64 READING LAMP CURRENT
READING POWER SUPPLY VOLTAGE #65
#66 IS INVERTED ?
N
Y
#67 ALTERNATION SIGNAL GENERATED
#68 ERROR CALCULATION
INTERRUPTION END

Fig. 18

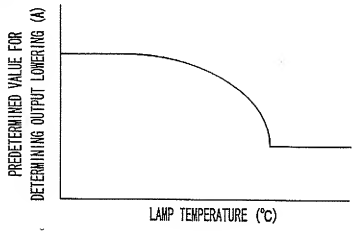
PREDETERMINED VALUE FOR DETERMINING OUTPUT LOWERING (A)
LAMP TEMPERATURE (°C)

Fig. 19A

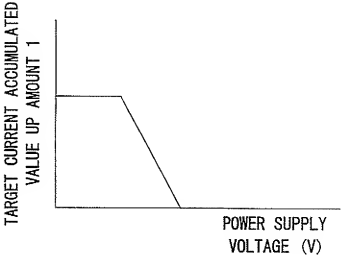

Fig. 19B

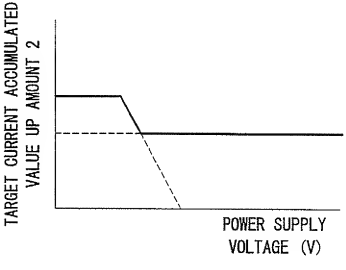

Fig. 20

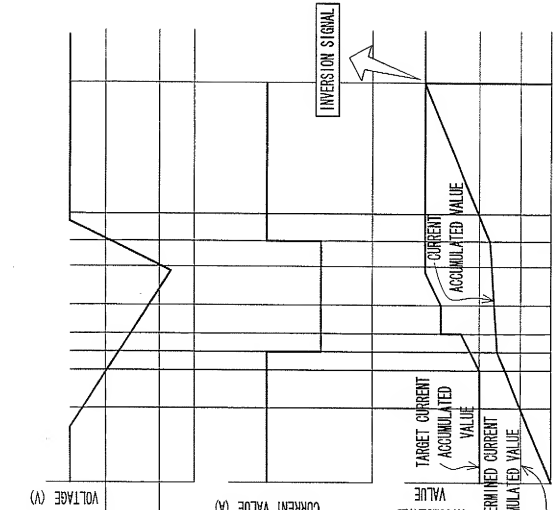
POWER SUPPLY VOLTAGE (V)
CURRENT VALUE (A)
CURRENT ACCUMULATED VALUE
TARGET CURRENT ACCUMULATED VALUE UP AMOUNT 1
TARGET CURRENT ACCUMULATED VALUE UP AMOUNT 2
TARGET CURRENT ACCUMULATED VALUE
PREDETERMINED CURRENT ACCUMULATED VALUE
INVERSION SIGNAL
a b c d e f g h i

Fig. 21

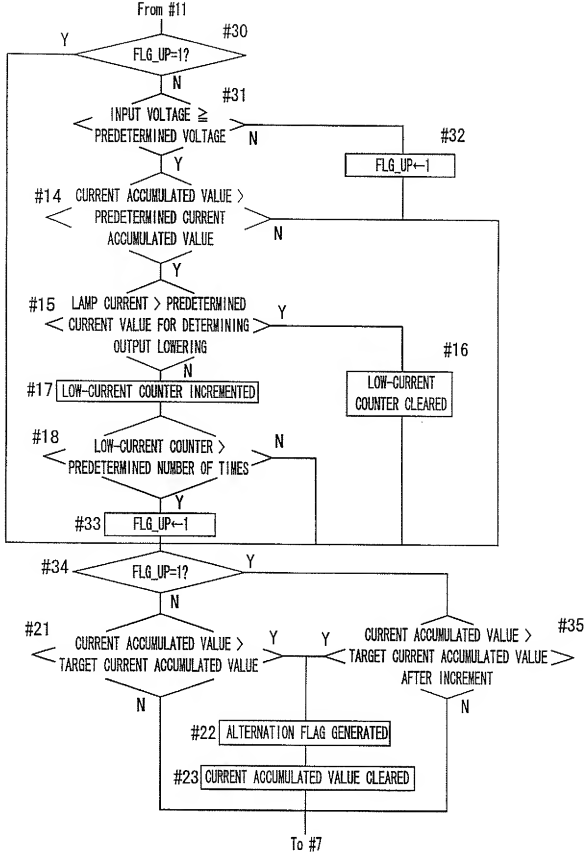
From #11
#30
FLG_UP=1?
Y
N
#31
INPUT VOLTAGE ≧ PREDETERMINED VOLTAGE
N
#32
FLG_UP←1
Y
#14
CURRENT ACCUMULATED VALUE > PREDETERMINED CURRENT ACCUMULATED VALUE
N
Y
#15
LAMP CURRENT > PREDETERMINED CURRENT VALUE FOR DETERMINING OUTPUT LOWERING
Y
#16
LOW-CURRENT COUNTER CLEARED
N
#17
LOW-CURRENT COUNTER INCREMENTED
#18
LOW-CURRENT COUNTER > PREDETERMINED NUMBER OF TIMES
N
Y
#33
FLG_UP←1
#34
FLG_UP=1?
Y
N
#21
CURRENT ACCUMULATED VALUE > TARGET CURRENT ACCUMULATED VALUE
Y
Y
#35
CURRENT ACCUMULATED VALUE > TARGET CURRENT ACCUMULATED VALUE AFTER INCREMENT
N
N
#22
ALTERNATION FLAG GENERATED
#23
CURRENT ACCUMULATED VALUE CLEARED
To #7

Fig. 22

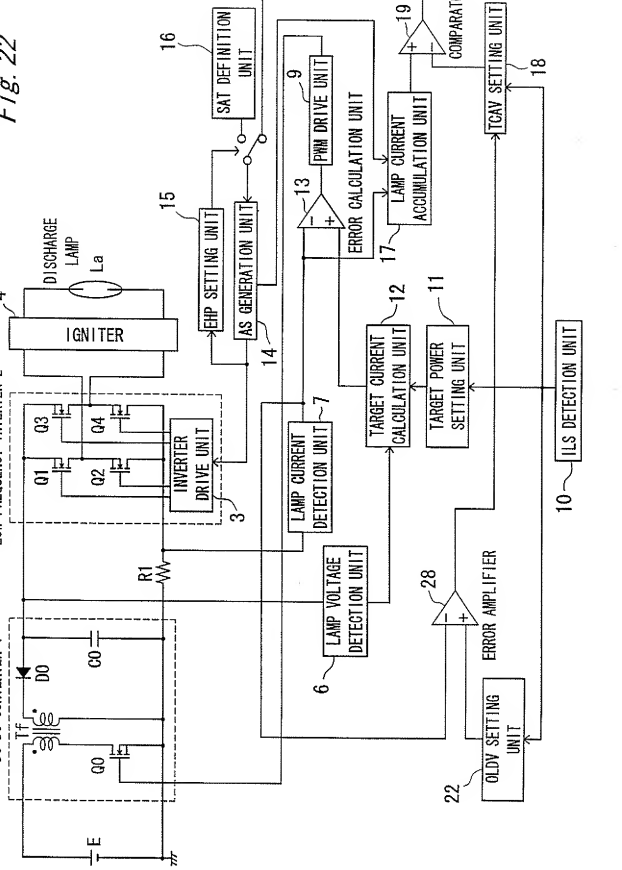
DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
DISCHARGE LAMP La
IGNITER
4
INVERTER DRIVE UNIT
3
Q0
Q1
Q2
Q3
Q4
D0
C0
Tf
E
R1
LAMP VOLTAGE DETECTION UNIT
6
LAMP CURRENT DETECTION UNIT
7
EHP SETTING UNIT
15
AS GENERATION UNIT
14
SAT DEFINITION UNIT
16
PRM DRIVE UNIT
9
ERROR CALCULATION UNIT
13
LAMP CURRENT ACCUMULATION UNIT
17
COMPARATOR
19
TGAV SETTING UNIT
18
TARGET CURRENT CALCULATION UNIT
12
TARGET POWER SETTING UNIT
11
ILS DETECTION UNIT
10
ERROR AMPLIFIER
28
OLDV SETTING UNIT
22

Fig. 23A

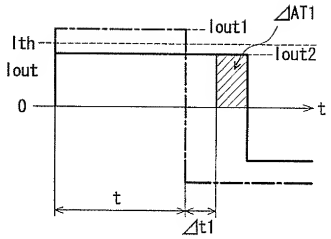

Fig. 23B

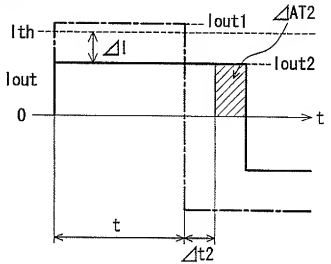

Fig. 23C

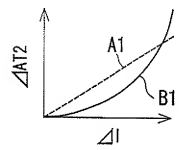

Fig. 24

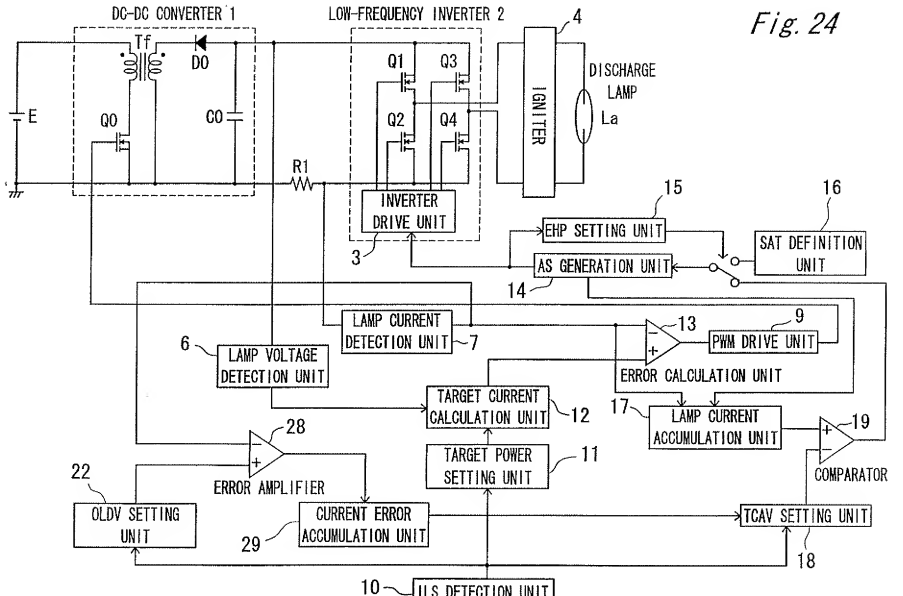
DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
4
Tf
DO
Q1
Q3
DISCHARGE LAMP
IGNITER
E
Q0
C0
Q2
Q4
La
R1
INVERTER DRIVE UNIT
15
16
EHP SETTING UNIT
SAT DEFINITION UNIT
3
AS GENERATION UNIT
14
LAMP CURRENT DETECTION UNIT
13
9
PWM DRIVE UNIT
6
LAMP VOLTAGE DETECTION UNIT
7
ERROR CALCULATION UNIT
TARGET CURRENT CALCULATION UNIT
12
17
LAMP CURRENT ACCUMULATION UNIT
19
28
TARGET POWER SETTING UNIT
11
22
ERROR AMPLIFIER
COMPARATOR
OLDV SETTING UNIT
CURRENT ERROR ACCUMULATION UNIT
29
TCAV SETTING UNIT
18
10
ILS DETECTION UNIT

Fig. 25A

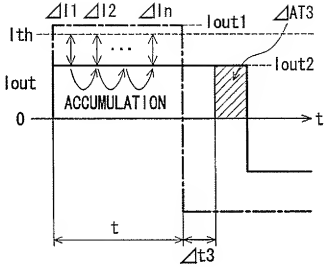

Fig. 25B

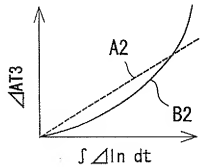

Fig. 26

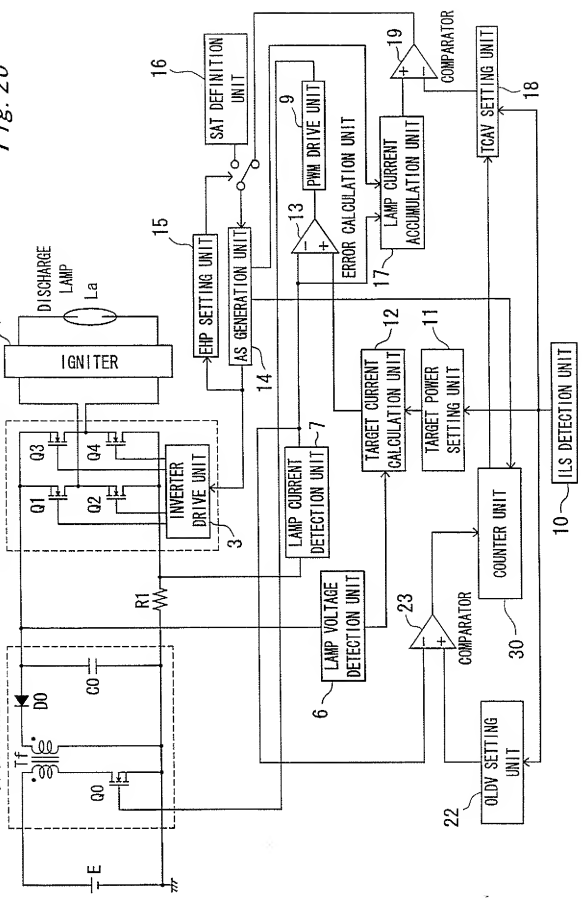
DC-DC CONVERTER 1
LOW-FREQUENCY INVERTER 2
DISCHARGE LAMP La
IGNITER
INVERTER DRIVE UNIT
LAMP CURRENT DETECTION UNIT
LAMP VOLTAGE DETECTION UNIT
TARGET CURRENT CALCULATION UNIT
TARGET POWER SETTING UNIT
ERROR CALCULATION UNIT
LAMP CURRENT ACCUMULATION UNIT
PWM DRIVE UNIT
SAT DEFINITION UNIT
EHP SETTING UNIT
AS GENERATION UNIT
COMPARATOR
TCAV SETTING UNIT
COUNTER UNIT
ILS DETECTION UNIT
OLDV SETTING UNIT
Q0
Q1
Q2
Q3
Q4
D0
C0
Tf
R1
E
3
4
6
7
9
10
11
12
13
14
15
16
17
18
19
22
23
30

Fig. 27A

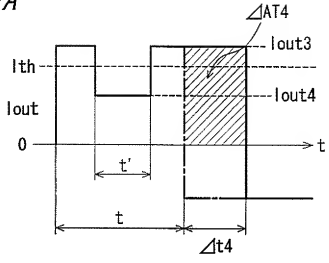

Fig. 27B

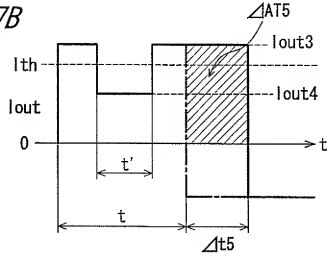

Fig. 27C

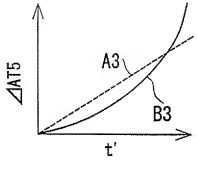

Fig. 28

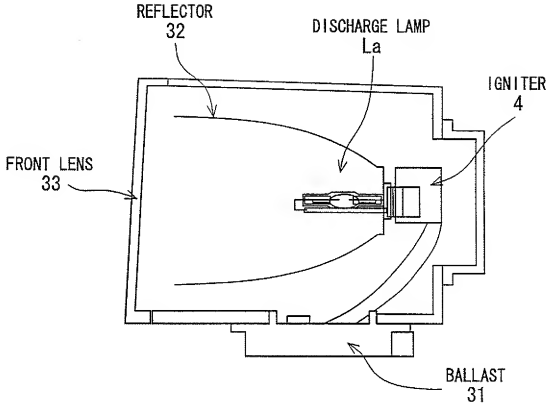
REFLECTOR
32
DISCHARGE LAMP
La
IGNITER
4
FRONT LENS
33
BALLAST
31

Fig. 29

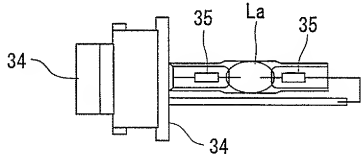
35
La
35
34
34

Fig. 30

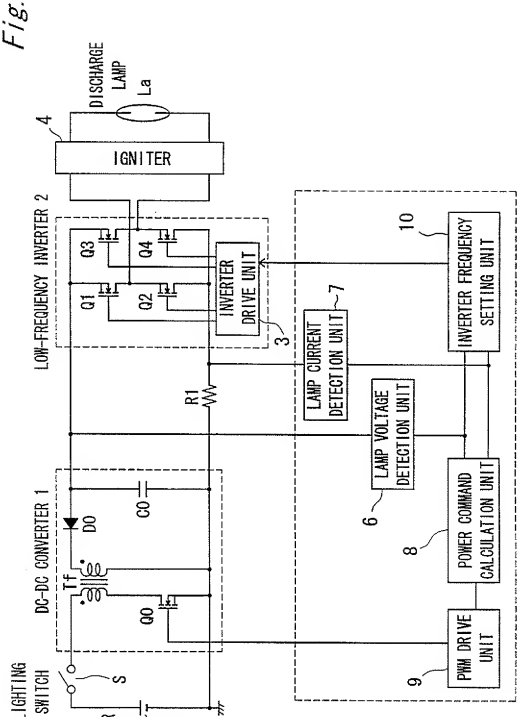
LIGHTING SWITCH
S
DC POWER SUPPLY
E
DC-DC CONVERTER 1
Tf
D0
C0
Q0
LOW-FREQUENCY INVERTER 2
Q1
Q2
Q3
Q4
INVERTER DRIVE UNIT
3
4
IGNITER
DISCHARGE LAMP
La
R1
LAMP CURRENT DETECTION UNIT
7
LAMP VOLTAGE DETECTION UNIT
6
POWER COMMAND CALCULATION UNIT
8
PWM DRIVE UNIT
9
INVERTER FREQUENCY SETTING UNIT
10
CONTROL CIRCUIT 5

Fig. 31A

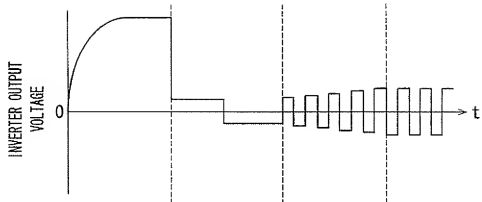

Fig. 31B

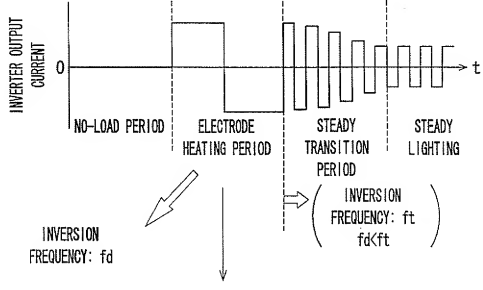
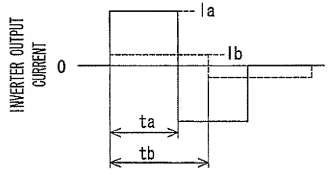
Fig. 31C